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THE VALUE OF EXTERNAL DIRECTION AND INDIVIDUAL DISCOVERY IN LEARNING SITUATIONS: THE LEARNING OF A GRAMMATICAL RULE. DIDAKOMETRY, NUMBER 18.

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Two methods of teaching a grammatical principle were compared in terms of initial learning results, positive and negative transfer, and retention. Forty-five pairs of sixth grade students, matched by sex and intelligence, formed two experimental groups. Group A was taught the principle and given practice with examples ("conventional" method) while Group B was given practice with examples only (discovery method). Neither group learned the principle completely, but Group A students reached a higher degree of initial learning and revealed greater positive transfer than Group B. However, they also showed more negative transfer (use of the rule where it did not apply) than Group B, and in a retention test given 5 weeks later, they forgot more, comparatively, than Group B. (AF)

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No. 18 February 1968

THE VALUE OF EXTERNAL DIRECTION AND INDIVIDUAL DISCOVERY IN LEARNING SITUATIONS: THE LEARNING OF A GRAMMATICAL RULE.

Abstract. - 45 pairs matched according to sex, line of study and intelligence, were selected out of four sixth grade classes. Group A was told the principle and allowed to practice it on a number of examples. Group B was given the practices only. It was found that group A learned the principle better, and was also better as to transfer. On a test of retention 5 weeks later there were no longer any differences between the groups.

This is a report from the School Mathematics Project at the School of Education, Malmö, Sweden. The study has been supported by grants from the Swedish Council for Social Science Research.

PROBLEMS

The "conventional" method of teaching puts great emphasis on grammatical studies in the learning of foreign languages. The pupils have to learn a rule by hearth and then demonstrate this rule in a number of examples. In the "Läroplan för grundskolan (1962) "which contains the curriculum for the Swedish compulsory school another method is recommended, however:

> "The grammar should only be the means to understand and use a language, not a goal. The study of grammar is based on the text and the speach, and the pupils are taught grammatical knowledge not through unnecessary analysis and rulegiving but through systematical exercises of different kinds .....
>
> To make learning more effective, it may in some cases be necessary to give a grammatical explanation or a rule. This should not be done, however, until the grammatical pattern has been practised in several examples".

We have found it of great importance to compare the "conventional" method of teaching, where you start with a rule and then use this in a number of examples with the so called discoverymethod, where you provide a number of examples and then let the pupils find out the rule by themselves. Which method is the most effective one as to learning, transfer and retention?

PREVIOUS INVESTIGATIONS

A number of studies have been made on the problem. Craig (1956) and Kittel (1957) stress the importance of the direction and guidance given by the teacher. Craig (1956) compared two groups to be able to ascertain the effect of teacher guidance versus the effect of a situation where the pupils had to find out the principle by themselves.

Group I recieved more help: They were told which principle provided the right answer while group II were only told that there was a principle. The pupils had to decide which of five encountered words did not belong to the others.

Craig found that Group I learned more than Group II. But they did not differ significantly as to retention and transfer. Craig recommended that the teacher should give a great deal of information, which would help the pupils to discover principles.

Kittell(1957) used the same material as Craig. He distinguished between three methods of teaching. A sample consisting of 132 sixth graders was divided into "the Maximum Group", which was told the principle and the correct answeres, "the Intermediate Group" which was told the principle but not the answeres, and "the Minimum Group" which was only told that a principle existed. Kittellfound that "the Intermediate Group" was superior to the others. "The Minimum Group" was inferior to "the Maximum Group".

Katona (1940) compared three methods of teaching geometrical problems. As Ss he used the pupils from three undergraduate classes. Method I, according to which the pupils had to learn the solution to a problem by heart, was the least good as to transfer. The best method was method III, the one where the pupils learned to apply the principle by the help of examples. Method III was better than method II, which taught the pupils how to solve the problems. Katona draws the conclusion that it is not necessary that one is able to verbalize a rule in order to apply it.

Hendrix (1947) discribed an experiment with three different methods of teaching mathematics. As Ss she used boys in 11th and 12th grade in a university high school and girls in a primary educational college. Group I was told the principle and it was illustrated to them, group II had to discover the principle and verbalize it and group III had to discover the principle but leave it unverbalized. The last method was found to be superior to the others.

Haslerud & Meyers (1958) performed the following study: An experimental group of 76 Ss with each S as his own control took two coding tests. The first of these tests contained 20 problems of coding. For half of these the Ss had to find out the rule by themselves, for the other half they were told the method. Test no. two, which was a multiple choice test, contained the 20 codes, which were used in the first test.

In test no. one the Ss coded significantly better on those problems where they were told the rule. In test no. two, which was given one week later, the scores were significantly increased for those problems which had previously been discovered, while they were decreased for those problems, where the rule had been given. Haslerud & Meyers drew the conclusion, that the discovered principles show better values on transfer than those where the principle was given.

Werdelin (1966 a) made an experiment where he compared external direction to individual discovery in the teaching of a mathematical method. He used three groups of 58, 63 and 67 Ss, selected at random from the student of seven sixth grade classes. Group A was given a mathematical principle and applied it to various examples: Group B was given most examples first, then told the principle, and given additional examples; and Group C was given examples only.

The results show that group A learned the principle better than the other two groups, but group C was comparatively better on transfer and retention. Group B was somewhere in between.

Werdelin (1966 b) also made another experiment on the problem. Three groups, each containing 58 Ss selected at random from seven 8th grade classes, were matched according to schoolastic achievement line of study and sex. The three groups were taught a foreign alphabet in different ways. Group A was told the principles of the aplhabet and applied it on examples; Group B was given most examples first, then told the principles; and Group C was given examples only. There were very small differences between the samples, but there was a clear indication that sample A learned the principle best, but sample C was comparatively better on tests which measured retention and transfer.

As we have seen Craig and Kittell stress the method of teacher quidance in the discovery of a principle, Katona, Hendrix, Haslerud & Meyers and Werdelin on the other hand stress the method of individual discovery of principles. The experiments are not directly comparable as they involve different choices of Ss and materials to be learned. The methods used by the experimenters differ from each other. More systematic and extensive experiments must be carried out in order to allow us to draw more general conclusions.

EXPERIMENT

As Ss pupils in four 6th grades in two schools were used. Altogether 107 pupils in these classes were first tested with the Swedish test of intelligence WIT III. The pupils were matched by sex, grade and the result of WIT III. By means of the matching, 51 pairs of students were obtained. Owing to some pupils being absent, the experiment included 45 pairs. The two groups, each with 45 Ss, are here named group A and group B. The individuals of the matched pairs were distributed at random on the two experimental groups.

In the experiment the pupils were taught to apply the following rule from the English grammar: Swedish infinitive renders into English with the form -ing after a preposition. The pupils do not normally learn this rule until a later stage in their education. We thereby compare two methods of teaching, observing their effect on learning, positive and negative transfer and retention. "The experiment was carried out like this:"

Each pupil, irrespective of group, gets a pamphlet of the following type: Page one contains examples of the type:

"We are tired of smiling-

Vi är trötta på att le",

as an application of the rule. The experimenter reads the English sentence and its translation and tells the class to repeat the English sentence in chorus. Page two contains five sentences in Swedish, which the pupil has to translate into English and thereby apply the rule.

Example:

"Jag är säker (sure) på (of) att vinna (win)."

This is to establish what stage of learning the rule the pupils had reached by help of the examples on page one. Words which may mean difficulties for the pupils are translated and put in parantheses. The experimenter reads the Swedish sentence and then allows a pause of 45 seconds during which the pupils write down their translations.

Pages 3, 5, 7 and 11 are of the same type as page 1. They contain eight examples for practising the rule. Pages 4, 6, 8 and 10 are of the same type as page 2 with five sentences in Swedish each to be translated into English. These pages are in the following named subtests 1, 2, 3, 4, 5, respectively. This is to get a measure of how the learning proceeds. On pages 12 and 13 at the end of the pamphlet there is a test containing five sentences where the degree of learning from earlier practice is tested. There are also 10 sentences where positive transfer is tested. In these examples which are new to the pupils new prepositions have been introduced. Nevertheless the same rule should still be applied. The test furthermore contains five sentences, where negative transfer is tested, that is to say sentences which are new to the pupil and where the rule must not be applied. The final test is given in identical form as a test of retention about five weeks later.

In group A each pupil gets the pamphlet and the following rule is presented orally as well as written on the blackboard:

"Let us look at this sentence: "Genom att hoppa. How do we say that in English? Yes "by jumping".

You can all see that there are three words in the Swedish sentence and only two in the English. Let us analyse the sentences; GENOM is a preposition; a preposition is a word like for example på, utan, av, med, förutom and från. In English these words are named: of, without, by, in, to,besides, and from. The next word in the sentence is ATT and the last word is a verb, The Swedish sentence then contains: preposition + ATT + verb. Let us look at the English sentence:
The first word is BY. That is as we said before, a preposition. What is HOPPA called in English? Yes, JUMP. But here it says JUMPING. There is an -ing added to the end of the verb. The English sentence then contains preposition + verb + -ing. The rule for all this says:

"When we in Swedish have preposition + att + verb, it is translated into English as: preposition + verb + -ing."
There is nothing comparable to ATT in English; they put an -ing to the verb instead.

Then a rule of thumb is given. The rule is repeated in a somewhat briefer form at the top of each page, including exercises, that is five times in all.

In group B the rule was never introduced. It was left to the pupils to discover it for themselves. Two examiners alternate giving the instructions in groups A and B.

SCORING PRINCIPLES

All sentences where the rule is correctly applied are marked as correct, even if they contain mistakes of a different sort, In the five sentences where negative transfer is tested and the rule must not be applied, the number of sentences where the pupil applies the rule in spite of this are noted. For each participant the result is worked out for each section and for the final test learning part, positive transfer part and negative transfer part separately to get a measure of learning, positive and negative transfer and retention.

RESULTS

Learning

The result is accounted for in table I. We compare the means of the scores of the first six tests in group A, the rule group, with the results for group B, the group without rules, and find that the former are higher on the whole. To test if the differences are significant we use the sign-test (8). In test I and II the differences are significant at the 5 % level, in subtest III and IV at the 1 % level. The differences increase somewhat from one part to another.
It is notable that the results for group A on subtest IV suddenly detoriates in comparison to test IV instead of improving as might be expected.

This fact may be caused by a levelling off at this point of the learning curve. Another possibility is that the apparent drop is a mere chance fluctuation. Group B shows an increase on test V compared to subtest IV, and it follows that there is no longer any significant difference between the average for groups A and B on test V. The average is still numerically somewhat higher for group A. For both groups we had expected an inferior result on part test VI compared to part test V. The five sentences of this sub test are mixed with fifteen sentences which are completely new to the pupils. This might assumed to be a confusing factor. Group B shows, as expexted, a drop, while group A rises in relation to sub test V. It is doubtful whether this would have been the case if the results in this group had not fallen on sub test V. The differences between the averages for groups A and B on sub test VI are significant at the 1 % level. In respect of learning, therefore, the rule method is more effective than the discovery method. Already from the first sub test the averages are higher for the rule group and the differences tend to increase successively.

Transfer

Table I indicates a higher result in group A than group B on positive transfer. The difference is significant at the 0, 5 % level. Where new prepositions are inserted, group A applies the rule correctly in a higher proportion of the sentences than group B. It would be of interest to know whether this would be the case if both groups had reached complete learning or at least the same stage of initial learning.

The medians on the negative transfertest are higher in group A than group B. The difference is significant on the 0, 5 % level. This implies that group A uses the form -ing to a greater extent than group B, even when this procedure is incorrect. The pupils in group A do not apply the rule in an intentional way. The lower result in group B may be for either of two reasons. Firstly, that the pupils in this group as a whole apply the -ing form to a lesser extent than group A, secondly that those who have learned the principle by the help of the discovery method also understand it.

Retention

Also on the test of retention group A has a higher average than group B. However the difference is not significant. In both groups the averages are considerably lower than they were on the same test five weeks earlier. The fact that the retention curve has fallen so sharply may be the result of the low level of original learning.

Have both groups forgotten the same amount in relation to their initial learning? To investigate this we calculate for each pupil the sum of correct answers on subtest VI and the test of positive transfer, both for the final test and the retention test (which are identical). In group A we find by help of the signtest, a difference between the two tests which is significant on the 0,1 % level, while the difference in group B is not significant. Group A has forgotten proportionally more than group B. This may be caused by more meaningful learning in group B, because meaningful learning makes better retention. Considering the form of the retention curve, however, we would expect those that have learned more to forget more.

The medians on negative transfer have dropped in both groups. According to the signtest, the difference in group A is significant on the 0,1 % level. All results on the retentiontest have dropped more in group A than in group B. When memory of the rule is gone the pupil does not make use of it any longer whether this is correct or not.

Do the less intelligent or the highly intelligent benefit more from being given the rule?

To compare the result of every pupil on WIT III and our test, we use Spearman´s rankcorrelation coefficient (8). We correlated the scores on WIT III with the total number of correct sentences on sub test I - VI. In group A the correlation is 0,59 and in group B 0,50. As a comparison can be mentioned that the correlation between intelligence and school-achievement is about the same. To answer the question above we divide the 45 matched paires according to their scores on WIT III, så that we get a "upper group" of 23 paires and a "lower group" of 22 paires. For each pupil we add the result of tests I - VI. Then we subtract the result of the group B pupils from those of the group A pupils. We use the differences as a measure of how much the pupils in group A have profited from being given the rule. Using the Mann-Whitney 0-test (8), we compare the differences in the upper and the lower group and find $z = -0,64$. There is thus no significant difference between the upper and the lower groups. Both have benefited as much from being given the rule.

TABLE I

SUBTESTS	GROUP A MEDIANS	GROUP B MEDIANS	PROBABILITIES OF DIFFERENCES BETWEEN GROUP A AND GROUP B.
LEARNING			
I	1, 20	0, 30	$0,01 < p < 0,05$
II	1, 91	0, 44	$0,01 < p < 0,05$
III	2, 15	0, 60	$0,001 < p < 0,005$
IV	3, 11	1, 63	$0,001 < p < 0,01$
V	3, 00	2, 08	$p \geq 0,1$
VI	3, 31	1, 19	$p < 0,001$
Positive transfer	4, 00	2, 75	$0,001 < p < 0,005$
Negative transfer	3, 13	1, 00	$0,001 < p < 0,005$
RETENTION			
VI	1, 19	0, 48	$p > 0,1$
Positive transfer	1, 00	0, 88	$p > 0,1$
Negative transfer	0, 37	0, 28	$p > 0,1$

SUMMARY AND CONCLUSIONS

From the experiment it appears that those pupils, who have been taught according to the "conventional" method of learning, the rule followed by examples, have reached a higher degree of initial learning than those, who had only examples. Neither of the groups managed to learn the principle completely. The low leavel of learning in the group which was given only examples can be explained by the fact that many of the pupils required a rule in order to discover the existence of a principle. The teachers in the four classes emphasised that the pupils were not used to translate from Swedish into English. Also in the case of positive transfer the "rule-group" produced better result than the group which got only examples. The groups are not directly comparable according to transfer, as they had reached different stages of initial learning.

The higher value in the "rulegroup" on negative transfer(which means that the pupils apply the rule even where this is not correct) points to the fact that they mechanically apply the rule, without really understanding its significance. Further indications that the "rule method" tends to encourage learning by heart rather than intelligent learning is that the pupils who have been taught in accordance with this method, when the time comes for the retentiontest have forgotten comparatively more than the group which has been taught by help of examples only.

Before one can be able to recommend a certain method of teaching problem in question must be penetrated by help of a number of systematical investigations. Other similar methods of teaching, not only dealing with the extremes as we have done here have to be tested. To get a situation which is more like the every day condition in school, it would be necessary to organise a longer course in accordance with the different methods, and to compare these from different points of view. Each part of the teaching is then more extended in time. Then you also have the opportunity to ascertain what effect the learning of one rule has on the learning of another and how the discovery of one principle can affect discovery of others. The different methods are then to be tested at many levels of the school as one might expect the effectiveness of the methods to depend on the general stage of the pupils ´developement.

REFERENCES

1. Craig, Directed versus independent discovery of established relations, J. educ. Psychol., 1956, 47, page 223-234.

2. Haslerud & Meyers, The transfer value of given and individually derived principles, J. educ. Psychol., 1958, 49, page 293-298.

3. Hendrix, A new clue to transfer of training, Elementary School J., 1947, 48, page 197 - 208.

4. Katona, Organizing and memorizing, New York: Columbia University Press, 1940.

5. Kittell, An experimental study of the effect of external direction during learning on transfer and retention of principles, J. educ. Psychol., 1957, 48, page 391-405.

6. Läroplan för grundskolan, Kungl. Skolöverstyrelsens skriftserie 60, Stockholm 1962, page 197-198.

7. Löfgren, Engelsk grammatik, Halmstad 1954, page 167.

8. Siegel, Nonparametric statistics for the behavioral sciences, Tokyo 1956.

9. Siegvald, Experimentella undersökningar rörande intellektuella könsdifferenser. I-II, Lund 1944, page 112 ff.

10.(a) Werdelin, The value of external direction and individual discovery in learning situations: The learning of a mathematical principle, Didakometry No 12, Malmö. Sweden: School of education, 1966.

11.(b) Werdelin, The value of external direction and individual discovery in learning situations: The learning of a foreign alphabet, Didakometry No 14, Malmö, Sweden 1966.

DIDAKOMETRY:

1. Bjerstedt, A. Mapping the pheno-structure of didactic sequences. (July 1964.)
2. Bjerstedt, A. Mapping the effect-structure of didactic sequences. (August 1964.)
3. Bjerstedt, A. Programmed instruction: A selective bibliographic guide. (September 1964. Rev. ed. November 1966.)
4. Holmberg, I. Programmed and conventional classroom instruction in arithmetic compared with respect to certain achievement, attitude, and behavior variables. (September 1965.)
5. Bjerstedt, A. Notes on programmed instruction in Sweden. (January 1966. Rev. ed. June 1966.)
6. Werdelin, I. A study of age differences in factorial structure. (February 1966.)
7. Jivén, L. M. A study of language laboratory teaching in German. (March 1966.)
8. Werdelin, I. A synthesis of two factor analyses of problem solving in mathematics. (March 1966.)
9. Werdelin, I. On the quality of the educational system as seen from the point of view of educational statistics. (April 1966.)
10. Holmberg, I. A combination of programmed instruction and teacher-supervised small group instruction compared with conventional classroom method. (June 1966.)
11. Larsson, B. Reliability and subjective probabilities. (October 1966.)
12. Werdelin, I. The value of external direction and individual discovery in learning situations: The learning of a mathematical principle. (November 1966.)
13. Bjerstedt, A. The terminology of programmed instruction: A selective list. (November 1966.)
14. Werdelin, I. The value of external direction and individual discovery in learning situations: The learning of a foreign alphabet. (November 1966.)
15. Bjerstedt, A. Programmed instruction in Great Britain: Notes from the Birmingham conference. (April 1967.)
16. Bjerstedt, A. Tele-observation: Closed-circuit television and video-recording in teacher training. (May 1967.)
17. Gréco, P. & Kirchberger, A. Enseignement programmé en U. R. S. S. (February 1968.)

EDUCATIONAL AND PSYCHOLOGICAL INTERACTIONS:

1. Bjerstedt, A. Developmental trends of life-space emphasis in dyadic communication. (July 1964.)
2. Bjerstedt, A. Assessment of interaction tendencies: Three approaches. (August 1964.)
3. Bjerstedt, A. Relational structure, relational plurels, and relational summaries. (September 1964.)
4. Bjerstedt, A. The rotation phenomenon in small groups. (January 1965.)
5. Bjerstedt, A. Interaction-oriented approaches to the assessment of student teachers. (February 1965.)
6. Bjerstedt, A. Current research projects in our department. (December 1965.)
7. Bjerstedt, A. (Ed.) Educational and psychological research in Sweden 1955—1965: A bibliography of publications in English. (February 1966. Rev. ed. June 1966.)
8. Werdelin, I. A study of attitudes towards school. (February 1966.)
9. Werdelin, I. Factor analyses of an inventory of behavior in social situations. (February 1966.)
10. Bjerstedt, A. The "autonomous" personality and the need for systematization. (March 1966.)
11. Werdelin, I. Teacher ratings, peer ratings, and self ratings of behavior in school. (March 1966.)
12. Werdelin, I. A school enrolment model. (April 1966.)
13. Werdelin, I. Demographic statistics and educational planning. (June 1966.)
14. Bjerstedt, A. Symbols of interaction potentialities: I. Movement patterns. (October 1966.)
15. Bjerstedt, A. Exploration of depression-elation phenomena: Background discussion and some methods of data collection. (November 1966.)
16. Cattell, R. B. & Bjerstedt, A. The structure of depression, by factoring Q-data, in relation to general personality source traits, in normal and pathological subjects. (November 1966.)
17. Bjerstedt, A. Symbols of interaction potentialities: II. Personal pronouns, an interlanguage study. (November 1966.)
18. Bjerstedt, A. Educational research in Sweden: Some areas of current and potential development. (December 1966.)
19. Werdelin, I. Factor analysis of a questionnaire of attitudes towards school work. (May 1967.)
20. Bjerstedt, A. & Sundgren, P. Teacher personality and teacher effectiveness. (June 1967.)
21. Bierschenk, B. Theorie und Praxis in der Oberstufe der schwedischen Grundschule. (June 1967.)
22. Werdelin, I. Statistics for educational planning and administration. I: Demography. (July 1967.)
23. Werdelin, I. Statistics for educational planning and administration. II: Population projections. (July 1967.)
24. Werdelin, I. Statistics for educational planning and administration. III: Manpower planning. (July 1967.)
25. Werdelin, I. Statistics for educational planning and administration. IV: Educational institutions. (July 1967.)
26. Werdelin, I. Statistics for educational planning and administration. V: Planning a school system. (July 1967.)

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